Welfare Analysis of a Tax Reform for Germany: A Comparison of the Unitary and Collective Models of Household Labour Supply
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ORIGINAL PAPER

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Welfare analysis of a tax reform for Germany: a comparison of the unitary and collective models of household labour supply

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Abstract We compare results of a tax reform analysis obtained with the collective and unitary models of household behaviour. We simulate real world micro-data by means of a collective approach, using a compound procedure of estimation and calibration based on the 1998 wave of the German socio-economic panel. We estimate a unitary model on this 'collective' data set. Investigating a move from joint to individual taxation on the basis of both models, we obtain important discrepancies between predicted adjustments to labour supply and distortions in the welfare analysis of the reform on the basis of unitary estimates.

Keywords Collective model · Household labour supply · Intra-household allocations

JEL Classification D11 · D12 · J22

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1 Introduction

Reforms of the tax and social benefit system generally have an impact on individuals' and families' living conditions and on their behaviour with regard to labour supply and consumption. Moreover, such reforms may affect the intra-household distribution of resources in ways that differ from the intentions behind them. In this paper, we analyse the impact a particular tax reform would (possibly) have in Germany, on households' consumption behaviour, on the labour supply of women and men, and on the within-family distribution of wealth.

In investigating these questions, an appealing representation of the decision process of the household is the collective framework introduced by Chiappori (1988, 1992) and Apps and Rees (1988). This type of model accounts for the presence of multiple decision makers within the household, in contrast to the traditional, or unitary, representation. Unitary models consider household behaviour as resulting from the decisions of a single unit, obscuring the fact that households are most of the time composed of several members. They treat the family as a 'black box'; thus, the within-family reallocation of resources resulting from a policy reform cannot be reconstructed. It is assumed that the household maximises a unique utility function, independent of prices and incomes. With the unitary models, only inter-household income inequality can be studied. Yet the question of intra-family redistribution can be crucial in determining household choices. These issues are important if policy makers want to conduct efficient and fair economic and social policies.

Drawing on the collective framework, on the contrary, opens up the possibility to infer aspects of the within-household welfare implications of policy changes. Collective models basically assume only Pareto-optimality of intra-household allocations, and this assumption defines the collective rationality of households. Chiappori (1988) distinguishes two cases, according to whether agents' preferences are egoistic or altruistic. If the agents have egoistic preferences and face a linear budget constraint or a convex budget set, their behaviour can be represented sequentially, using an explicit income-sharing rule (Donni 2003; Beninger 2003). Otherwise, a sequential representation of household behaviour is no longer possible, but this behaviour still results from the sharing of consumption between agents (Chiappori 1988).

Previous work by Beninger and Laisney (2002) addressed these issues on the basis of purely synthetic data. Their study reveals important discrepancies (1) in the incentive and distribution effects of revenue-neutral reforms based on unitary estimates rather than on the true collective parameters, (2) in predicted adjustments of labour supplies following a switch between two tax regimes (individual and joint taxation for couples), and (3) it also provides evidence of conflicting results when welfare analyses of policy reforms are based on unitary estimates rather than collective estimates. The aim of the present paper is to check the robustness of these results when the 'collective baseline situation' does not result from synthetically simulated households but is rather generated by a model-based on reasonable assumptions, giving results close to reality, thanks to the use of calibration.

A main contribution of this study will be a concrete comparison of the implications of the choice between the two representations mentioned above. The question is whether the predictions of labour supply responses to a tax reform and the changes of the distribution of welfare vary substantially with the representation chosen. Our goal is to quantify the distortions that may affect policy recommendations obtained with the unitary representation.

To compare the two settings, we cannot rely on an estimation strategy, in contrast to Moreau and Donni (2002), as the full estimation of a collective model with 'non-convex' budget sets and a participation decision for both spouses is a difficult task, which has not yet been achieved. To circumvent this problem, we simulate real world micro-data by means of a 'deterministic' collective labour supply model. A unitary model is then estimated on this 'collective' data set where households behave according to the collective rationality. The evaluation of a tax reform based on these two models allows the comparison of the performance of the collective and the unitary models of family behaviour.[1]

The outline of the paper is the following. In Section 2, we describe the steps used for the construction of our collective data set. This includes a brief description of the German tax–benefit system and an introduction to the German Socio-Economic Panel (GSOEP) data we use to define the collective baseline situation. Section 3 presents the estimation and simulation results for the unitary model. In Section 4, we describe the reform considered and analyse it on the basis of both the collective and the unitary model. We also compare the simulated effects of the tax reform in the collective world with those predicted by the unitary model. A particular emphasis is put on the intra-household effects within the collective setting. Section 5 concludes.

2 Construction of a 'collective' data set

Our real world collective data are calibrated so as to reflect the characteristics (labour supply, household income/consumption level) of couples of the 1998 wave of the GSOEP in a realistic way. Our strategy relies on the assumption that some aspects of individual preferences—but not all—concerning own consumption and leisure are the same for single and married women or men. To take up possible utility-producing complementarity effects of leisure, a term accounting for interaction between spouses' leisures, namely a 'cross-leisure effect', is also considered. Under these assumptions, we estimate individual preference parameters for singles and use these estimates to simulate collective data for couples simply by exploiting the Pareto-optimality assumption for the household decision process. This allows us to retrieve both the cross-leisure effect and a power index for each couple, by calibration on GSOEP couple data. We then regress this calibrated power index on a set of variables, including some original variables describing the way in which the tax and benefit system affects the relative net earning potential of each spouse. We subsequently predict the power index for different tax situations and thereby simulate the effects of a tax reform on spouses' consumption levels and labour supplies. The reform studied here consists of a revenue-neutral switch from joint to individual taxation.

[1] Here, to save space, we focus on a single reform, namely a revenue neutral move from joint to individual taxation. Further evidence for Germany concerning a revenue neutral move to a linear tax system is given in Beninger et al. (2006). Results for other European countries (Belgium, France, Italy, Spain and the UK) can be found in Laisney (2002) and Myck et al. (2006).

We resort to calibration to avoid the difficult task of estimating a collective model with non-convex budget sets and non-participation, but the path followed here could eventually be extended from calibration to estimation, the crucial identifying assumption being the similarity of preferences of individuals before and after marriage. In the simpler context of two earner households and linearised budget restrictions, this approach was also followed by Barmby and Smith (2001) and by Browning et al. (2004) when estimating equivalence scales.

2.1 Data

We use the 1998 wave from the GSOEP, a representative panel data sample of households and individuals living in Germany. The panel gives a wealth of information on the labour market status of individuals and on the various income sources of families.

We selected German nationals aged between 25 and 55 years. All are employees with a contractual labour supply of at least 10 h/week or individuals who are voluntarily out of employment. The restriction on hours is introduced to avoid the occurrence of extraordinarily high wage rates, as the ratio of earnings over hours, for people with less than 10 h. We excluded the self-employed from the sample, as well as individuals in parental leave or in education or registered as unemployed.

The sample of singles consists of 488 individuals: 208 women and 280 men. A 'single' is defined as an individual with the above characteristics and living alone. He or she may have dependent children living outside the household. We also selected 1,332 families composed of a married couple and, possibly, dependent children. This means that we excluded households comprising other adults than those of the married couple. As for singles, dependent children may live outside the household.

Table 1 shows descriptive statistics for single and married women and men, respectively. The regional indicator East Germany should capture social, educational, economic and cultural differences between both parts of the country, at least partially. Given our selection, single women from Eastern Germany are under-represented in the sample (approximately 20% of the population live in the East, which is correctly reflected for men). Singles are generally characterised by a younger age, higher schooling level, more university graduates and a remarkably higher participation rate, particularly among women. Single men have, on average, a higher level of vocational education than women. This concerns essentially West Germans, but the proportion of people with polytechnic or university degree is lower in the East. Wives have, on average, lower schooling and vocational education level than husbands. The main financial resource of single men and women is earnings. The unearned income can be negative because of maintenance payments to children, parents or ex-partner.[2] Men pay, on average, more maintenance than women. A high proportion of singles has positive capital income. In contrast, only few of the singles in our sample receive social benefits.

[2] Admittedly, the fact that maintenance payments may depend on income creates an endogeneity problem, which we shall neglect here.

Table 1 Descriptive statistics on the selected samples

	Single women		Single men		Married women		Married men	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Participation	0.94		0.96		0.71		0.97	
Age	37.2	9.44	36.7	7.98	39.5	7.04	41.9	7.34
Schooling[a]								
No degree	0.03	[b]	0.04		0.02		0.01	
Short secondary	0.34		0.35		0.41		0.31	
Long secondary	0.23		0.21		0.12		0.19	
Other	0.03		0.02		0.06		0.06	
Vocational training[c]								
No training	0.13		0.06		0.10		0.05	
Technical training	0.21		0.18		0.24		0.25	
University or polytechnic	0.14		0.18		0.08		0.15	
East Germany	0.14		0.20		0.28		0.28	
Separated or divorced	0.27		0.32					
Never married	0.66		0.68					
Widowed	0.07		0.00					
# Children	0		0		1.40	1.06	1.40	1.06
No children	1		1		0.22		0.22	
1 child	0		0		0.31		0.31	
2 children	0		0		0.36		0.36	
≥3 children (#)[d]					3.39	0.28	3.39	0.28
Hours work (week)	36.8	5.65	38.9	6.40	30.1	10.4	39.6	5.53
Gross wage (hour)[e]	13.1	4.75	14.6	5.75	11.6	5.17	15.6	6.56
Capital income	40.1	72.1	42.4	74.9	52.1	143.5	52.1	143.5
Child benefit	131.2	45.9	147.6	64.2	206.0	124.8	206.0	124.8
Total unearned income (month)[f]	49.5	195.5	30.4	234.2	321.9	459.1	321.9	459.1
Observations	208		280			1,332		1,332

[a] Reference category: primary school, short and long secondary school correspond to 'Realschulabschluß' and 'Abitur'

[b] Variables, for which only the mean is shown, are indicator variables

[c] Reference category: apprenticeship; technical training and polytechnic correspond to 'Fachschule' and 'Fachhochschule'

[d] For this and the four subsequent variables, statistics concern only positive values

[e] For this and the three subsequent variables, nominal values are in euro

[f] Total unearned income also includes rental and leasing, social benefit, housing benefit, incomes of children and net maintenance payments; highly negative net maintenance may lead to negative total unearned income

More than half of the married couples live with, at most, one child. Similar to singles, only few couples receive housing or social benefits. Most of them have capital income. As is the case for singles, married men pay on average a little more maintenance than married women.

There are no large discrepancies in the distributions of hours of work between men and single women. Both present a sharp mode around 40 h. But the distribution of hours of married women is very different. Married women have a significantly lower participation rate than married men or singles, and the distribution of their labour supply is spread more evenly. Married women work more often in part-time jobs, and their weekly working time distribution has a mode at 20 h.

2.2 The 1998 German tax–benefit system

For our exercise, we apply a simplified form of the 1998 German tax and benefit system.[3] The latter is characterised by a comprehensive tax that covers labour earnings and income from other sources, such as capital investment, housing rents etc., and social transfers. The function applied to the tax base (i.e. the sum of incomes minus the standard deductions) is smoothly progressive, with a top rate of 53% for yearly earnings in excess of 61,376 euro. Earnings below the basic personal allowance of 6,322 euro are tax-free. Joint taxation is the rule for married couples.

Parents can opt for either a child benefit (112.48 euro monthly for the first and the second child, 153.39 euro for the third and 178.95 euro from the fourth child on) or a child allowance, that is a yearly lump sum deduction of 3,534 euro for each child up to age 27, if still in education or doing military or civil service. The social benefits include housing benefit and special payments. They are means-tested, depend on the number of people in the household and on the geographical location (they are paid by the local governments).[4] As a simplification, we assume that the maximum of social benefit a person can receive is 511.29 euro a month and 357.90 euro for the partner. These amounts are reduced by 10% for people living in East Germany.[5] Figure 1 reveals the non-convexity of the resulting budget constraint when labour earnings are high enough for social benefit payments to cease.

2.3 A collective baseline situation for Germany

To obtain a data set representing the collective world for Germany, we use a four-step procedure (for details on the data construction, see Beninger et al. 2003 and Vermeulen et al. 2006).

First, we estimate separately preference parameters for single men and women. This involves also the estimation of wage equations. For the estimation, we assume linear-expenditure-system type preferences for single individuals, and we use a

[3] This simplification is an adaptation to our particular sample and emphasis of the micro-simulation program developed at ZEW (for a description see Jacobebbinghaus and Steiner 2003).
[4] In our static setting, we ignore unemployment insurance and unemployment benefits, which are both related to former earnings. Both transfers actually require the search of, and the willingness to take up, a job.
[5] The maximum social benefit we have computed is based on statistics given by the Federal Statistical Office (Statistisches Bundesamt 2003).

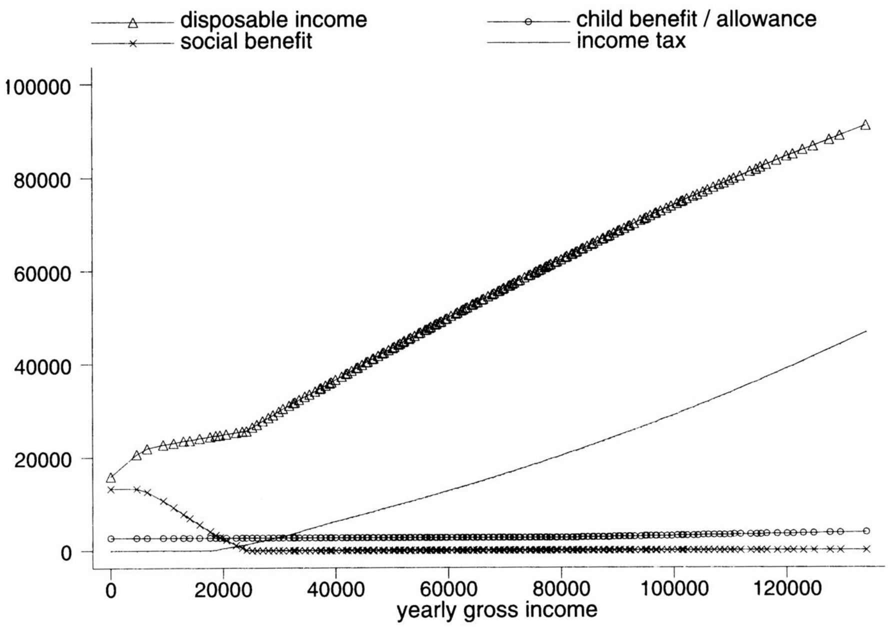

Fig. 1 The 1998 German tax–benefit system. The figure illustrates the situation of a couple with two children. The wife and the husband earn 18 and 25 euros per hour, respectively. At low levels of labour income, they are eligible to means-tested social benefit

multinomial logit model with mass points on the consumption coefficients to account for unobserved heterogeneity (see Heckman and Singer 1984; Hoynes 1996).[6] Using the estimates, we predict singles' labour supply and the corresponding consumption level.

We look here only at point predictions, disregarding the extreme values errors underlying the multinomial logit probabilities. Creedy and Kalb (2005) forcefully argue in favour of obtaining predictions by simulations including these errors. However, in our context, we do not consider these errors as an integral part of the model and view the mixed multinomial logit model only as an estimation device. The main point is that the choices made in the discretization of hours are essentially arbitrary. Different choices will imply different errors (and even different numbers of errors). We would not consider it illicit to obtain predictions for other discretizations than the one used in estimation, on the basis of the estimated preference coefficients. This attitude comforts us in not taking these errors too seriously. Moreover, in the collective framework, where we use a mix of estimation and calibration and solve an optimisation program to obtain the predictions, it is not clear how we should simulate, and if it were, it would be extremely burdensome. Thus, for the sake of comparability and economy, we consider only point

[6] We also estimated a random parameter logit model (RPL, see e.g. McFadden and Train 2000) with a normal distribution for the constant terms in β_c^i and β_l^i. We obtained significant dispersion for the consumption term, but not for the leisure term, both for men and women. The specification with mass points on β_c^i alone strongly dominated the RPL specification, both in terms of likelihood and in terms of accuracy of predictions. Note that an ordered model would be out of place here because of the complex budget restriction.

predictions for all models. This should not affect the main message of the paper. The proportion of exact predictions is about 85% for women and 75% for single men.

In a second step, we use a calibration method to determine the partners' relative weights in the bargaining process taking place in the household and to compute a leisure interaction coefficient describing the effect of the leisure of the spouse on each individual's utility. The calibration is done by optimising the fit of predicted to observed hours of work. By introducing a cross leisure term, we relax the strong assumption of separability of individual preferences between both spouses, which is usually made in the empirical literature on collective models. Apart from this cross leisure term, we assume that married individuals have the same preference parameters as singles. Formally, we assume the following functional form for the utility function of spouse i in household h, parameterised by a vector z_h of variables related to children in the household, and by the spouse's leisure l_j:

$$\begin{aligned} U_i(c_i, l_i; z_h, l_j) &= \beta_c^i \ln\left[c_i - \bar{c}_i(z_h)\right] + \beta_l^i \ln\left[l_i - \bar{l}_i(z_h)\right] \\ &\quad + \delta_i(z_h) \ln\left[l_f - \bar{l}_f(z_h)\right] \ln\left[l_m - \bar{l}_m(z_h)\right] \\ &\quad \forall i, j = f, m, \end{aligned} \tag{1}$$

where $\delta_i(z_h)$ represents the cross leisure effect on the spouses' utilities. $\bar{c}_i(z_h)$ and $\bar{l}_i(z_h)$ represent the minimum consumption and leisure. $\bar{c}_i$ corresponds to the sample minimum of the potential disposable income. $\bar{c}_i$ increases by 51 euro per child, which corresponds to minimum needs caused by an additional child as officially assigned by the governmental authorities (Statistisches Bundesamt 2003). $\bar{l}_i$ is set to 87 and 94 h/week for childless husband and wife. These amounts increase with the presence of children, depending on their age. Our calculations rely on a study by Beblo (2001), and a report of the Federal Statistical Office (Statistisches Bundesamt 1995). For details, see Beninger et al. (2003). A referee pointed out that the utility of a single is then obtained by assigning some value to the leisure of the (absent) spouse. Perhaps more intuitively, this is also the amount of my spouse's leisure that gives me the same level of utility as if I were single. Eq. 1 shows that this is 1 h in excess of the spouse's subsistence amount of leisure $\bar{l}_i$. The presence of δ means that we do not restrict our attention to 'egoistic' or 'caring' agents (see Chiappori 1992). As mentioned above, we assume that the β coefficients are unaffected by marriage, and we obtain them from the estimates for singles. We basically suppose that the household behaves collectively, i.e. the spouses' decisions are Pareto-optimal:

$$\begin{aligned} &\max_{c_f, c_m, l_f, l_m} U_f^k \\ &s.t. \begin{cases} U_m \geq U_m^k \\ c \leq g(l_f, l_m, w_f, w_m, y, \phi), \end{cases} \end{aligned} \tag{2}$$

where $g(.)$ represents the tax–benefit system, w_i the wages, y the unearned income, and φ a set of tax-relevant household characteristics. U_i^k is the utility level reached by spouse i at point k of the Pareto frontier. We select K+1 (K=50) points on the Pareto frontier with the following coordinates on the horizontal axis:

$$U_m^k = U_m^{\min} + \frac{k}{K}\left(U_m^{\max} - U_m^{\min}\right) for\ k = 0, \ldots, K, \quad (3)$$

where $U_m^{\min}$ and $U_m^{\max}$ are the minimum and maximum utility, respectively, the man can reach. A simple index of the male's bargaining power is then: $\omega_m = k/K$. Note that this procedure allows us to draw an empirical Pareto frontier for each couple in the sample.

Approximately only 42% of the households in our sample turn out to have a convex utility set, or, in other words, a concave Pareto frontier. Figure 2 documents a non-concave Pareto frontier obtained for our sample. The calibration consists of a δ_h for each household [temporarily adopting the restriction $\delta_f(z_h) \equiv \delta_m(z_h)$] and the 'power index' ω_m, so as to optimise the fit of predicted hours to observed hours:

$$\left(\overline{\omega}_m, \overline{\delta}\right) \in \underset{w \in W}{\operatorname{argmin}}\left\{\left[h_f^* - h_f(\omega_m, \delta)\right]^2 + \left[h_m^* - h_m(\omega_m, \delta)\right]^2\right\}, \quad (4)$$

where h_i^* is the observed labour supply. W denotes the set of possible values for the pair $w \equiv (\omega_m, \delta)$. In fact, we also calibrate over the regimes resulting from the mixed multinomial logit estimation of the singles' preferences:

$$\left(\overline{\omega}_m, \overline{\delta}, \overline{r}_f, \overline{r}_m\right) \in \underset{w \in W}{\arg\min}\left\{\left[h_f^* - h_f\left(\omega_m, \delta, r_f, r_m\right)\right]^2 + \left[h_m^* - h_m\left(\omega_m, \delta, r_f, r_m\right)\right]^2\right\}, \quad (5)$$

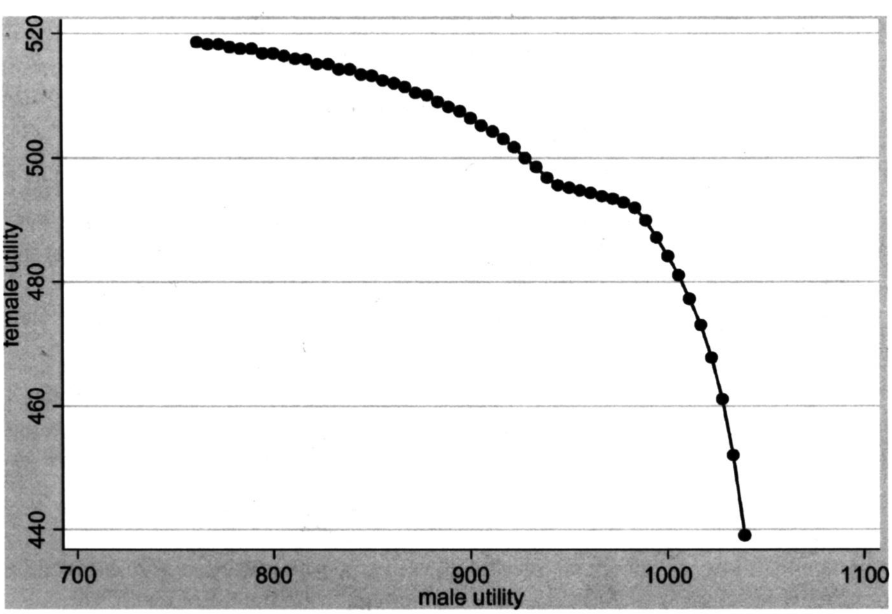

Fig. 2 A non-convex utility set (U_m on the *horizontal axis*, U_f on the *vertical axis*)

Table 2 Logistic regression results for the power index

Parameter	East Germany			West Germany		
	Coefficient	SE	*t* value	Coefficient	SE	*t* value
y_d^{40}				−0.16	0.02	−6.20
age	−0.01	0.00	−2.81	−0.01	0.00	−2.89
dage				0.01	0.01	3.69
sch_real	0.11	0.04	2.98			
sch_abi	0.13	0.05	2.73			
job_noap	−0.56	0.15	−3.66			
job_fach				0.06	0.02	3.37
nchild	0.06	0.02	3.19			
*child*0	−0.37	0.08	−4.40	−0.24	0.02	−9.95
*child*3	−0.16	0.05	−3.05	−0.11	0.02	−5.49
*child*7	−0.04	0.03	−1.56			
*child*16				−0.05	0.02	−2.73
Constant	−0.01	0.11	−0.02	0.22	0.07	3.31
Adjusted R^2		0.126			0.196	

y_d^{40}, her relative earning potential at 40 h, taking account of the tax system, as explained in the text; *age*, her age; *dage*, her age minus his age; *sch_real*, *sch_reabi*, *job_noap*, and *job_fach*, indicator variables for short secondary schooling, long secondary schooling, no vocational degree, technical training, and polytechnic or university degree, respectively; *nchild*, number of children; *child*0, *child*3, *child*7, and *child*16, number of children in the household less than 3 years old, between 3 and 6 years, between 7 and 12 years, and over 16 years, respectively

The initial list of explanatory variables x we started with in the logistic regression included, besides y_d^{20}, y_d^{20} and the age difference variable reported in the table, income variables like capital income and child benefits, and a whole set of socio-demographic variables. Using variables $y_d^{20}, y_f^{20}, y_f^{40}$ and y_m^{40} instead or on top of y_d^{40} proved inferior

where r_i represents the regime for spouse i. In case of multiple solutions, we select the combination for which, lexicographically, $\overline{\omega}_m$ is closest to $\overline{\omega}_f$, the female's power index defined as $\overline{\omega}_f = \left(\overline{U}_f - U_f^{\min}\right) \Big/ \left(U_f^{\max} - U_f^{\min}\right)$, and $\overline{\delta}$ is closest to 0. To normalise the power indices of the spouses so that they sum to one whilst taking account of the degree of concavity of the Pareto-frontier at the optimum, we compute the variable α solving $\overline{\omega}_f^{\alpha} + \overline{\omega}_m^{\alpha} = 1$. The distribution of α is documented in Table 3.

The third step consists of estimating a logistic equation relating the calibrated normalised power index $\overline{\omega}_m^{\alpha}$ (Fig. 3) to a set of explanatory variables, that is, an equation of the type

$$\ln\left[\overline{\omega}_m^{\alpha} / \left(1 - \overline{\omega}_m^{\alpha}\right)\right] = x\gamma + \varepsilon, \tag{6}$$

which will allow us to obtain predicted values $\widehat{\omega}_m^{\alpha}$ between 0 and 1 given x. Important variables to include in x are variables capturing the way in which the tax–benefit system influences the relative earning potential of the spouses. If these turn

Table 3 Statistics on re-calibrated cross leisure effects and $\widehat{\omega}_m$

	No child	1 Child	2 Children	≥3 Children	Total			
	Mean	Mean	Mean	Mean	Mean	SD	Min.	Max.
$\bar{\delta}_f$	−4.17	−3.34	−3.63	−3.43	−3.63	3.22	−12	6
$\bar{\delta}_m$	0.21	0.02	0.21	0.62	0.19	2.23	−8	6
$\widehat{\omega}_m^{\alpha}$	0.52	0.49	0.51	0.53	0.51	0.08	0.33	0.93
α	1.18	1.10	1.21	1.32	1.18	0.42	0.74	8.30
No.	296	410	478	148	1332			

δ corresponds to the cross_leisure term estimated for the unitary model. $\bar{\delta}_f$ and $\bar{\delta}_m$ are calibrated values from the collective model, for female and male respectively. $\widehat{\omega}_m^{\alpha}$ is the predicted value of the normalised male power index defines in the text below Eq. 4. α is the corresponding measure of curvature of the Pareto-frontier (α=1 is the linear case)

out to contribute significantly to the prediction of $\overline{\omega}_m^{\alpha}$, they will allow us to describe changes in the power index induced by tax reforms. Here, we consider two such variables, y_d^{40} and y_d^{20} defined as follows. Let p_f^k and p_m^k denote the observed sample frequencies of (discretised) weekly labour supplies h^k, k=1,..., H, of wives and husbands, respectively. Denote $R_{mk}^{fk'}$ as the household disposable income when the husband works h^k hours and the wife works $h^{k'}$ hours. Variable y_f^{40}, defined as

$$y_f^{40} = \sum_{k=1}^{H} p_m^k \left(R_{mk}^{f40} - R_{mk}^{f0} \right), \tag{7}$$

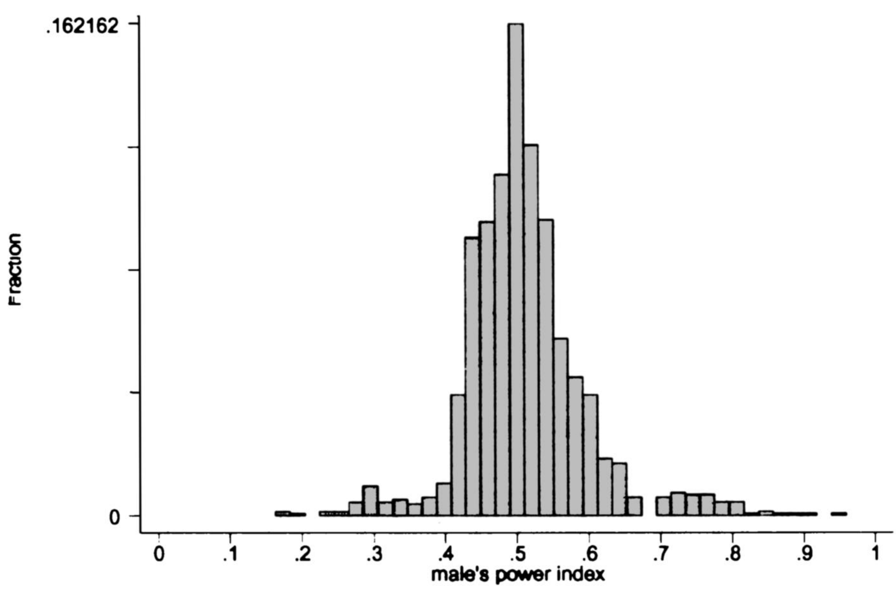

Fig. 3 Distribution of the calibrated normalised power index of the man

then measures the expected increase in the household disposable income if the wife switches from 0 to 40 h, the expectation being taken over the male hours distribution. Defining y_f^{20} and y_m^{40} similarly, we then consider the two ratios $y_d^{40} = y_f^{40} / y_m^{40}$ and $y_d^{20} = y_f^{20} / y_m^{40}$, which we term 'relative earning potential of the wife at 40 h' (resp. 20). These ratios depend on the tax–benefit system, and it is the cross-sectional variation in them that identifies the effect of the tax system on the power index. Clearly, a more reliable identification could be obtained by using data covering a tax reform, along the lines of Blundell et al. (1998). Table 2 gives the results of the estimation conducted separately for East and West Germany. The power index is related to age, qualification and children. The relative earnings potential variable is significant only for West Germany.

Hours predictions obtained with the predicted $\widehat{\omega}_m^{\alpha}$ and calibrated $\overline{\delta}$ turn out not to be very accurate. Thus, we choose in a fourth step to re-calibrate separate leisure interaction terms δ_m and δ_f for husband and wife given the predicted power index $\widehat{\omega}_m^{\alpha}$. The couple solves the following maximisation problem:

$$\max_{c_f, c_m, l_f, l_m} U_f \quad s.t. \begin{cases} U_m \geq \widetilde{U}_m \\ c \leq g(l_f, l_m, w_f, w_m, y, \phi) \end{cases}, \tag{8}$$

where $\widetilde{U}_m$ is such that:

$$\widetilde{U}_m = U_m^{\min} + \widehat{\omega}_m \left(U_m^{\max} - U_m^{\min} \right). \tag{9}$$

We allow for different cross leisure terms for both partners. Thus, the couple's choice (c_f, c_m, l_f, l_m) now depends on the combination (δ_f, δ_m).

Table 3 documents the results of the re-calibration of $\overline{\delta}$ and $\widehat{\omega}_m^{\alpha}$. The cross leisure effect $\overline{\delta}_f$ turns out to be surprisingly negative for most women. We would rather have expected to find a majority of households with complementary leisures. The result that leisures are substitutes (in direct utility) for so many women may be partly due to the inappropriateness of the way in which we import the β coefficients estimated for singles into the preferences of individuals in couples and to the insufficiency of our efforts to distinguish between domestic production and leisure time. Further research is needed here. $\overline{\delta}_f$ increases with the number of children, the exception being that mothers of a single child present the largest average. The cross leisure effect for men, $\overline{\delta}_m$, is positive on average. As for women, it increases with the number of children, except that childless men have the same average coefficient as fathers of two children. In our model, the asymmetry in the labour supplies of husbands and wives thus translates into an asymmetry in the impact of the spouse's leisure on utility, rather than in an asymmetry in bargaining power. Indeed, the power index values obtained suggest a balanced power sharing in German households.

We obtain a good fit: both for wives and for husbands, almost 90% of the observations are located on the diagonal. However, the fit deteriorates considerably if we use predicted rather than calibrated values of the cross leisure effects δ_i. Less than 29% of the labour supplies of wives are correctly predicted. The percentage for the husbands is much higher, but still, we obtain very bad predictions for some men. For example, 2.4% of the husbands are predicted to work full time although they actually do not work. These deviations may be due to factors that we are not able to control, such as health condition or wealth. In view of these results, we decided to use the calibrated values of the leisure interaction terms, rather than their predictions, in the definition of the baseline situation to be used in simulating the effects of fiscal reforms. Whilst we may appear to favour the collective model by using the calibrated, rather than the predicted, values of δ_i, we should recall that we are not performing a symmetric comparison of the unitary and collective models here. Our objective is more limited: we want to quantify the distortions resulting from the use of a unitary model when the data are generated by a collective model.

3 Estimation of a unitary model

The unitary model is estimated on the baseline collective data.

3.1 Model specification

For the specification of the unitary model, we adopt the analogue to the individual utility functions used in the collective model (Eq. 1), that is:

$$\begin{aligned}\widehat{U}(c, l_f, l_m; z) &= \beta_c(z)\ln[c-\bar{c}(z)] + \beta_f(z)\ln\left[l_f-\bar{l}_f(z)\right] + \beta_m(z)\ln\left[l_m-\bar{l}_m(z)\right] \\ &\quad + \delta(z)\ln\left[l_f-\bar{l}_f(z)\right]\ln\left[l_m-\bar{l}_m(z)\right]. \end{aligned} \tag{10}$$

Note that, by using aggregate consumption as argument in the utility function rather than introducing the individual consumption of husband and wife as separate argument, we place ourselves in the common situation of consumption surveys, where only aggregate consumption of the household is typically available.[7]

The β and δ functions of characteristics z are assumed to be linear, and the minimum requirements in consumption and leisure are set to the values calibrated for the collective model. Of course, the budget constraint remains the same as for the collective model.

Since each spouse has H labour supply choices, the couple has H^2 possible combinations. If $\widehat{U}_j = \widehat{U}\left(c^j, l_f^j, l_m^j; z\right)$ denotes the utility generated by combination j of the set of combinations $\left\{\left(c^j, l_f^j, l_m^j\right)_{j=1}^{H^2}\right\}$, adding an error term ε_j to

[7] The conditions under which this utility function is increasing in its arguments and concave are given in Beninger et al. (2003). Actually, we also experimented with direct translog utility functions along the lines of Van Soest (1995), but with a quadratic form in logs of departures from minimal requirements, as in Eq. 10. Although several specifications were superior to this one in terms of likelihood, all led to utility functions that were non-increasing in at least one argument for a majority of observations.

the utility derived from combination j, we have:

$$\widehat{U}_j = \widehat{U}\left(c^j, l_f^j, l_m^j; z\right) + \varepsilon_j \quad \forall j = 1, \ldots, H^2. \tag{11}$$

The distribution of ε_j is assumed to be the extreme value distribution defined by:

$$\Pr\left[\varepsilon_j < \varepsilon\right] = \exp\left(-\exp\left(-\varepsilon\right)\right), \quad \varepsilon \in \mathbb{R}. \tag{12}$$

If combination j turns out to be the best possible choice for the family, we have:

$$\Pr\left[\widehat{U}_j > \widehat{U}_k, \forall k \neq j\right] = \frac{\exp\left[\widehat{U}\left(c^j, l_f^j, l_m^j; z\right)\right]}{\sum_{k=1}^{H^2} \exp\left[\widehat{U}\left(c^k, l_f^k, l_m^k; z\right)\right]}. \tag{13}$$

The above expression corresponds to the density function of the multinomial logit model. As for the singles, we also estimate a discrete mixture of such models, with two to three mass points on the coefficient of $\ln\left[c - \overline{c}(z)\right]$. The estimation results are given in Appendix.

3.2 Base case predictions with the unitary model

Tables 4 and 5 show the predictions obtained for wives and husbands. The unitary model performs less well than the collective model in predicting labour supplies. Predictions are correct for only a third of the wives and for 45% of the husbands. The margins of the tables are not very well predicted, except as regards the participation rate. The results for cells within the tables are bad. The unitary model tends to smooth the distribution of the labour supply. The mode on full-time working is significantly lower for the unitary model, both for women and men: 80% of the husbands work full-time, but only 49% are predicted to work 40 h. The labour supplies are under-predicted on average. This points to the mis-specification of the model, at least concerning the particular unitary model estimated here.

4 Predictions of the effect of the move to individual taxation

We analyse the welfare effects of the switch from joint to individual taxation. This reform entails a replacement of joint with individual taxation on the basis of the 1998 tax schedule. Tax liabilities are scaled down by a factor f=0.942 in the collective model and by a factor f=0.894 in the unitary model to obtain revenue neutrality. The computation takes account of singles and of sampling weights. Specifically, denoting R_o, the baseline government tax revenue, and $R(f)$, the post_reform tax revenue for factor f given behavioural adjustments, we solve equation $R(f)$=R_o in f. This is a conceptually simple problem, but given the complexity of the function $R(f)$, it is numerically burdensome, and we chose to stop the iterative algorithm after a small number of iterations, yielding the solution up to the third decimal position. It is important to note that the definition of a revenue-neutral reform differs if it is based on the unitary rather than on the collective model, because the predicted behavioural adjustments differ.

Table 4 Collective vs unitary female labour supply, joint taxation

	0	10	20	30	40	50	60	Total
0	**15.99**	6.98	3.30	2.10	0.30			28.68
10	4.13	**0.90**	1.28	0.90				7.21
20	6.76	3.75	**3.45**	2.48	0.75			17.19
30	2.63	1.88	2.78	**2.93**	2.70	0.23		13.14
40	3.30	2.63	3.90	9.23	11.49	2.70		33.26
50	0.23			0.08	0.08			0.38
60	0.08			0.08				0.15
Total	33.11	16.14	14.71	17.79	15.32	2.93	0.00	1,332

Rows show the wives' collective labour supply, columns are unitary. Entries in the body of the table and in the margins give frequencies (in percent), except the last cell, which gives the number of observations. Bold entries materialise the diagonal

4.1 Changes in the power index in the collective model

Recall that the predicted power index depends on a variable, which reflects the wife's relative earning potential at 40 h, taking account of the complete tax system. Thus, the power index is potentially affected by a tax reform. Table 6 summarises its distribution for the two tax–benefit systems we consider, based on the estimates given in Table 2.[8]

There is a slight reduction in the mean and in all quantiles of $\widehat{\omega}_m^{\alpha}$, and Figure 4 shows that changes are small for all individuals and that there are few increases. The reason for the reduction in the mean lies in the improved relative earning potential of women, y_d^{40}, connected with the fact that they typically have lower wages than their husbands. Individual taxation then lowers their marginal tax

Table 5 Collective vs unitary male labour supply, joint taxation

	0	10	20	30	40	50	60	Total
0	**0.45**	0.60	0.30	0.23	1.35	0.23		3.15
10		**0.08**		0.08	0.23	0.08		0.45
20				0.15	0.30			0.45
30	0.30	0.83	0.45	**1.20**	4.58	2.70	0.08	10.14
40	1.35	8.93	3.30	8.71	**40.47**	16.14	0.60	79.50
50		0.23	0.08	0.15	1.73	**3.68**	0.30	6.16
60						0.15		0.15
Total	2.10	10.66	4.13	10.51	48.65	22.97	0.98	1,332

Rows contain husbands' collective labour supply, while columns provide unitary data. Entries in the body of the table and in the margins give frequencies (in percent), except the last cell, which gives the number of observations. Bold entries materialise the diagonal

[8] These predictions are obtained using the baseline distributions of male and female hours.

Table 6 Estimated normalised power index for the two tax–benefit systems

	No.	Mean	SD	Min.	10%	50%	90%	Max.
$\widehat{\omega}_m^{\alpha joint}$	1,332	0.510	0.076	0.333	0.428	0.496	0.609	0.927
$\widehat{\omega}_m^{\alpha ind}$	1,332	0.506	0.076	0.330	0.426	0.492	0.604	0.927

$\widehat{\omega}_m^{\alpha joint}$ and $\widehat{\omega}_m^{\alpha ind}$ denote normalised power index of male for 1998 and individual taxation, respectively

rate. Because of this shift of the bargaining position in favour of women, we expect the reform to be relatively more beneficial for married women than for married men.

4.2 Changes in tax revenues

Table 7 summarises tax revenues from different population subgroups under the two tax regimes. Marital status is an important determinant of the direction of change in tax liabilities. The individual tax reform is beneficial to the singles. On the other hand, the status quo (splitting system) is favourable to couples, and even when the spouses adapt their labour supply to the new situation of individual taxation, couples have higher tax liabilities under individual taxation. Ignoring the behavioural adjustments on the labour market, the tax liability of couples would increase by 18%. Table 7 also highlights that using a unitary model for estimating

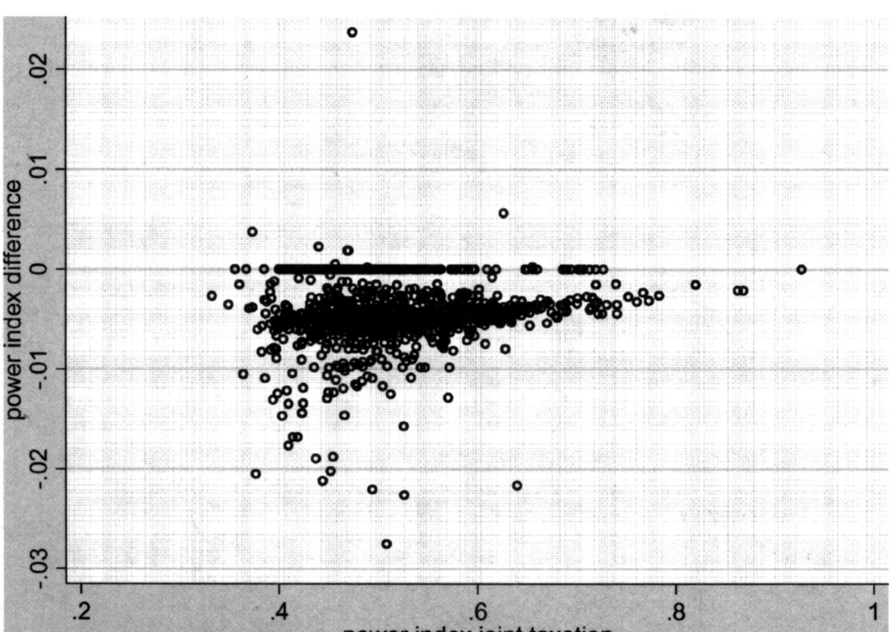

Fig. 4 Difference in male power index, after − before the reform

Table 7 Tax revenues in billion euro

	Collective		Unitary		Static (collective)
	Joint tax	Individual tax	Joint tax	Individual tax	Individual tax
Single women	8.92	8.39	8.92	7.99	8.92
Single men	15.58	14.68	15.58	14.01	15.58
Couples	44.10	45.54	44.71	47.22	52.03
Total	68.59	68.61	69.21	69.22	76.53

Approximate revenue neutrality is obtained by multiplying the tax liability in the case of the individual taxation by a factor $f=0.942$ for the collective model and $f=0.894$ for the unitary model. The last column gives the tax revenues in the static version, based on the collective baseline situation. To obtain tax neutrality, the tax liability should then be scaled down by a factor $f=0.895$

the effects of a tax reform would introduce distortions in computing the aggregate impact of that reform on the different subgroups of the population. For example, believing the results stemming from the unitary predictions, single individuals would be relatively more favoured by the move to individual taxation.

4.3 Positive aspects of the reform

Recall that the baseline situation used for the unitary model consists of the predictions obtained from that model. Table 8 compares participation rates before and after the reform, as predicted by the collective and unitary models. Note that for singles, the predictions for individual taxation only differ because of re-scaling of the tax scheme (to ensure revenue neutrality). The largest discrepancies between collective and unitary predictions are obtained for wives.

Table 9 documents joint variations in labour supply within the household. A salient feature of this table is that the most frequent cell is (0,0) for about half of the cases. For 3.2% of the households, there is substitution of his hours of work for her hours of work (his hours decrease and hers increase), whilst there is complementarity for 1.4%. Table 10 documents joint variations in the labour supply of husbands and wives as predicted by the unitary model. As with the actual variations in the collective setting, more than half of the couples do not adjust their hours of work under the new tax rule. Here, the percentages for substitution and complementarity are 8.6 and 2.2%, respectively. Both women and men are

Table 8 Participation rates in percent

	Collective model		Unitary model	
	Joint	Individual	Joint	Individual
Wives	71.33	81.09	76.89	84.68
Husbands	96.85	97.38	97.90	98.87
Single women	94.23	94.23	94.23	94.23
Single men	97.85	97.85	97.85	97.85

Table 9 Δ work hours of couples, joint–individual tax: wives vs husbands (collective model)

	−30	−20	−10	0	10	Total
−30			0.08			0.08
−20				1.50		1.50
−10			**0.83**	19.89		20.72
0	0.08	0.23	5.18	**49.47**	0.38	55.33
10	0.08		2.18	14.26	**0.38**	16.89
20			0.60	3.90	0.15	4.65
≥30			0.30	0.53		0.83
Total	0.15	0.23	9.16	89.56	0.90	1,332

Rows present wives' hours, while columns present husbands' hours. Bold entries materialise the diagonal

predicted to increase hours more than we would expect from the results obtained with the collective model.

Table 11 compares the predicted female labour supply adjustments of both models. Whereas the unitary model seems to predict that women tend to increase their labour supply under individual taxation, the collective setting predicts labour supply changes in both directions. Overall, the reaction in hours worked is slightly under-estimated for the wives—almost 60% of the wives have an unchanged labour supply according to the unitary model but only 55% in the collective setting —and over-predicted for the husbands (table not presented here).

4.4 Normative aspects of the reform

Figure 5 describes the welfare effects of the reform measured at the *household* level by the unitary model by showing the distribution of percentage changes in household utility for every decile of the pre-reform distribution of the household

Table 10 Δ work hours of couples, joint–individual tax: wives vs husbands (unitary model)

	≤−10	0	10	20	≥30	Total
−10		0.15	0.23			0.38
0	3.15	**51.73**	4.43	0.08		59.38
10	6.31	26.28	**0.90**			33.48
20	2.10	2.25		**0.15**	1.13	5.63
≥30				0.30	**0.83**	1.13
Total	11.56	80.41	5.56	0.53	1.96	1,332

Rows present wives' hours, while columns present husbands' hours. Bold entries materialise the diagonal

Table 11 Δ female work hours, joint–individual tax, collective vs unitary

	−10	0	10	20	≥30	Total
−30	0.08					0.08
−20		1.20	0.60	0.08		1.88
−10		13.21	5.48	1.58	0.08	20.35
0	0.30	**33.71**	18.32	2.03	0.90	55.26
≥10		11.26	**9.08**	1.96	0.15	22.45
Total	0.38	59.38	33.48	5.63	1.13	1,332

Rows, collective; columns, unitary. Bold entries materialise the diagonal

equivalent disposable income.[9] This type of graph requires cautious interpretation. Considering percentual changes does not by itself permit inter-personal or inter-household welfare comparisons. But given that the composition of deciles is fixed, such a graph may convey a feel for the importance of welfare effects. What is well defined (i.e. based on ordinal utility) is the information on proportions of winners and losers by decile. The graph shows the quartiles of the distribution (box). The lines emerging from the box extend upwards to the largest utility change smaller than $Q_{75}+1.5(Q_{75}-Q_{25})$ and downwards to the smallest utility change larger than $Q_{25}-1.5(Q_{75}-Q_{25})$. Observations outside this range, if any, are plotted individually. The unitary model shows a balanced distribution of losers and winners, and some very large losses and gains, especially at high income levels. Surprisingly, the welfare gain from individual taxation increases on average with equivalent income.

Individual welfare effects of the reform, measured for husbands and wives separately within the collective framework, are described in Figures 6 and 7 by showing the distribution of percentage changes in individual utility for every decile of the pre-reform distribution of the wives' or husbands' equivalent disposable income.[10] The figures show that, in the collective case, individual taxation is only advantageous for women in the higher equivalent income deciles. Men show some large gains and losses at all income levels.

A direct comparison of the welfare analysis based on the two models is made on the basis of cross-tabulation of the positions of households (winner, indifferent, loser) with the pairs of positions of the spouses, whereby a cutoff ±0.1% change has been adopted to define indifference. Table 12 indicates that 36% of the couples lose, as well as 29% of the women, but that for men, the proportion of losers is higher and attains 57%. The percentage of 'Pareto-winning' households (i.e. combinations ++, +0, 0+) is only 18%; there are 27% 'Pareto losers' (− −, −0, 0−), and 22% 'contradictory' entries (h+,−0), (h+,0−), (h+,− −), (h+,00), (h0,++), etc. The percentage of households for which the move to individual taxation generates 'conflicting' effects for husband and wife is as high as 39%. Other results, not

[9] The equivalence scale for the household disposable income is the modified OECD scale: 1 for the first parent, 0.7 for the second, 0.6 for each child more than 16 years old, 0.5 for each child between 7 and 15 years and 0.4 for each child younger than 6 years.

[10] The equivalence scale for the individual disposable income is 1 for the parent (the wife or the husband) and the same as above for the children.

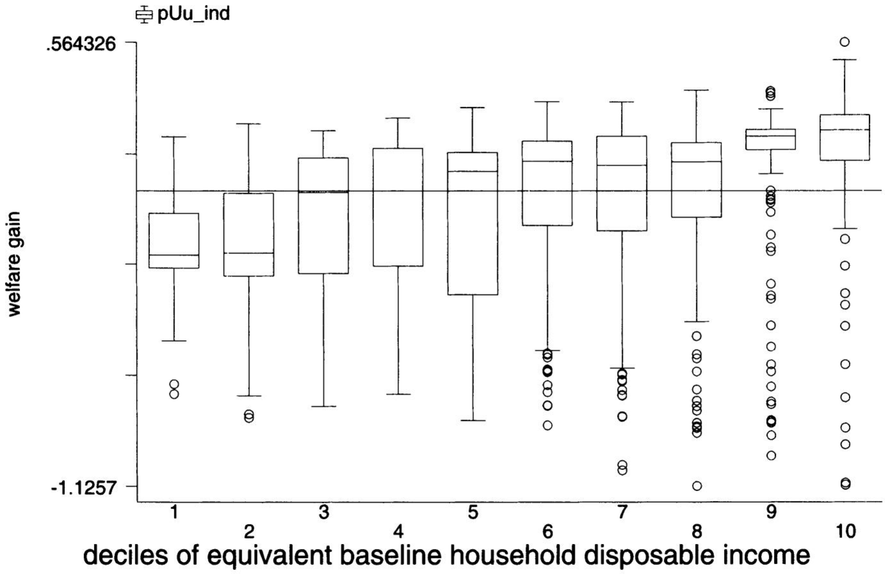

Fig. 5 Relative welfare gains from a switch to individual taxation for households, unitary model. Each of the *ten box plots* shows the quartiles of the distribution of welfare gains in the corresponding decile. The *lines* emerging from the box extend upwards to the largest utility change smaller than $Q_{75}+1.5(Q_{75}-Q_{25})$ and downwards to the smallest utility change larger than $Q_{25}-1.5(Q_{75}-Q_{25})$. Observations outside this range, if any, are plotted individually

illustrated here, show that the collective model predicts richer women without children to fare better under individual taxation, whereas the unitary model suggests that couples without children are disadvantaged by the reform.

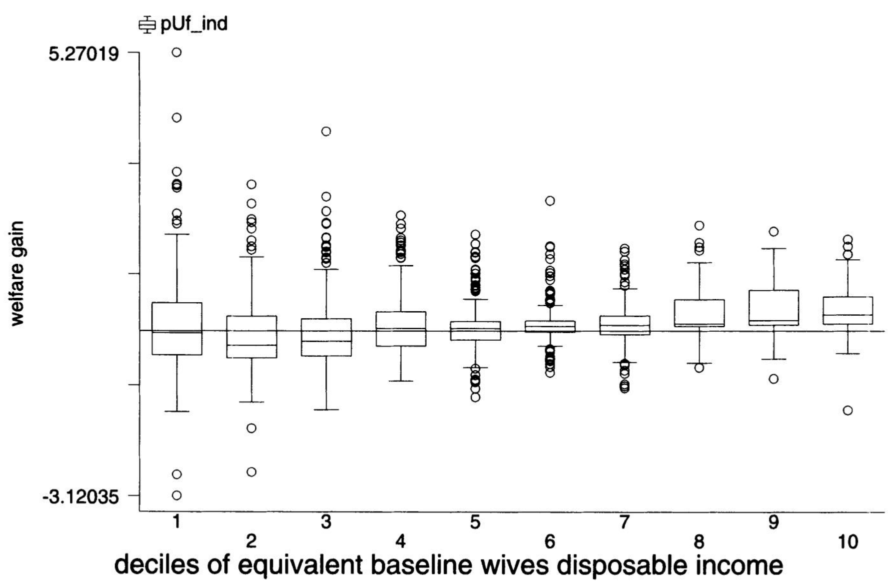

Fig. 6 Relative welfare gains from a switch to individual taxation for married women, collective model

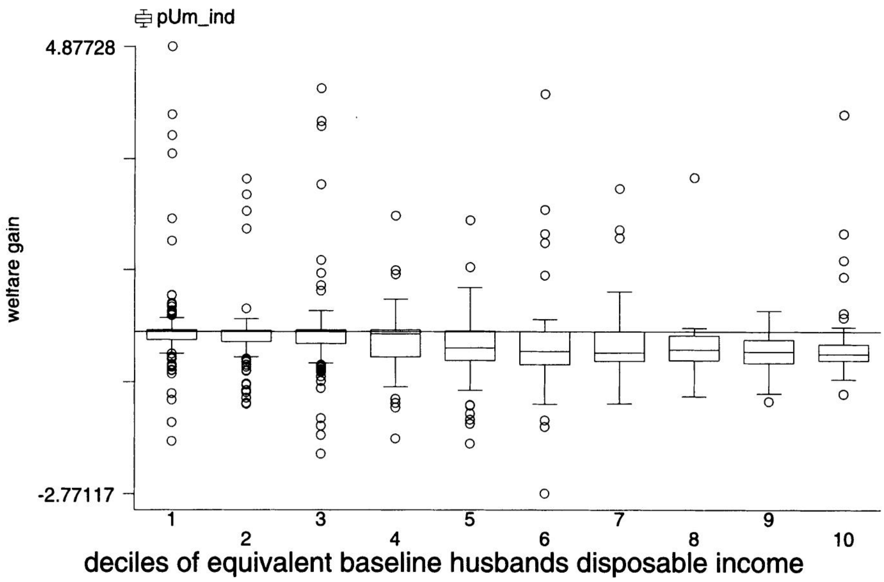

Fig. 7 Relative welfare gains from a switch to individual taxation for married men, collective model

5 Conclusion

The aim of this study was to illustrate the distortions arising in policy evaluation on the basis of a unitary model when the real world, in fact, follows collective rationality. We have tackled this question by simulating micro-data within a collective setup and by estimating a unitary model on these data. A comparison of the collective data and the unitary estimation results showed that in the baseline situation, on average, labour supply is under-predicted by the unitary model. In

Table 12 Winners and losers: collective vs unitary model, individual taxation

	f_- m_-	f_- m_0	f_- m_+	f_0 m_-	f_0 m_0	f_0 m_+	f_+ m_-	f_+ m_0	f_+ m_+	Total
$hous_-$	11.71	3.08	3.38	2.10	3.38	0.45	10.89	1.05		36.04
$hous_0$	3.75	0.68	1.28	0.68	5.86	0.15	6.01	1.28		19.67
$hous_+$	3.60	1.05	0.45	0.90	5.41	0.38	17.42	14.79	0.30	44.29
Total	19.07	4.80	5.11	3.68	14.64	0.98	34.31	17.12	0.30	1,332
Total f	(f_-)	28.98		(f_0)	19.29		(f_+)	51.73		1,332
Total m	(m_-)	57.06		(m_0)	36.56		(m_+)	6.38		1,332

Move from the 1998 joint system to individual taxation. Rows correspond to winning ($hous_+$), indifferent ($hous_0$) and losing ($hous_-$) couples, on the basis of the estimated coefficients of the unitary model. Households are considered indifferent if their post-reform utility level is the same ±0.1% as before the reform. Columns correspond to the winning, indifferent or losing wives and husbands on the basis of the simulated 'collective' data. Spouses are considered indifferent if their post-reform utility level reform is the same ±0.1% as before the reform total, only a third of female labour supply decisions are correctly predicted, as well as 40% of the males'.

In terms of policy evaluation, the distortions entailed by the use of the wrong model may be even more interesting. A first distortion shows up in the '*design*' of the tax reform. Whilst a revenue-neutral move from joint to individual taxation, realised by proportional scaling of tax liabilities, leads to a factor of 0.942 with the collective model, the unitary model leads to a much lower factor of 0.894. The predictions concerning changes in the distribution of the tax burden on couples and singles, whilst going in the same direction of a shift from singles to couples, are of starkly different magnitudes.

As regards changes in labour supplies, the unitary predictions do well for less than half of the wives. Overall, in the collective setting, the labour supply of married women is more responsive to the reform, whereas with the unitary model, more men are predicted to alter their labour supply. That is, when basing policy evaluations on estimations from the unitary model whilst living in a collective world, we underestimate the changes in hours for wives and overestimate the changes for husbands.

As for the normative aspects of the reform, we have looked at changes in household utility (unitary model) and changes in individual utility (collective model). In a comparison of the predictions of both setups, 22% of the conclusions at the household level turn out to be contradictory. That is, both spouses are predicted to be affected in one way by the collective model, and the household is predicted to be affected in the opposite way by the unitary model.

Finally, an aspect that is totally ignored by the unitary model turns out to be quantitatively important. The collective model reveals that the reform has conflicting effects for 39% of the households: that is, a welfare gain is predicted for the wife and a loss for the husband or vice versa. Note that these within-household implications of a policy measure can only be uncovered by using a multi-person model of household behaviour where husband and wife are considered as distinct decision makers with individual preferences.

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Appendix

Estimation results for the unitary model

Table 13 Mixed multinomial logit estimates of preferences for couples: three mass points

		Coefficient	SE	*t* value
β_K^f	$\ln(l_f - \bar{l}_f) \times kid$	5.27	1.15	4.6
β_{K6}^f	$\ln(l_f - \bar{l}_f) \times kid6$	1.01	0.30	3.4
β_{sr}^f	$\ln(l_f - \bar{l}_f) \times \text{sch\_real}_f$	−0.55	0.25	−2.2
β_{ju}^f	$\ln(l_f - \bar{l}_f) \times job\_uni_f$	0.92	0.40	2.4
$\beta_{r_3^f}^f$	$\ln(l_f - \bar{l}_f) \times reg3_f$	5.02	0.52	9.6
β_0^f	$\ln(l_f - \bar{l}_f)$	−0.80	0.70	−1.1
β_K^m	$\ln(l_m - \bar{l}_m) \times kid$	3.15	1.21	2.6
β_{ju}^m	$\ln(l_m - \bar{l}_m) \times kid6$	1.12	0.31	3.7
β_0^m	$\ln(l_m - \bar{l}_m)$	1.40	0.76	1.9
$\delta_{a_f^2}$	$\ln(l_f - \bar{l}_f) \times \ln(l_m - \bar{l}_m) \times (\ln age_f)^2$	0.12	0.01	9.5
δ_K	$\ln(l_f - \bar{l}_f) \times \ln(l_m - \bar{l}_m) \times kid$	−1.38	0.31	−4.5
δ_{K6}	$\ln(l_f - \bar{l}_f) \times \ln(l_m - \bar{l}_m) \times kid6$	−0.34	0.11	−3.0
δ_{sr_f}	$\ln(l_f - \bar{l}_f) \times \ln(l_m - \bar{l}_m) \times sch\_real_f$	0.56	0.11	5.0
δ_{sa_f}	$\ln(l_f - \bar{l}_f) \times \ln(l_m - \bar{l}_m) \times sch\_abi_f$	0.49	0.14	3.5
δ_{sa_m}	$\ln(l_f - \bar{l}_f) \times \ln(l_m - \bar{l}_m) \times sch\_abi_m$	0.15	0.06	2.6
δ_{jn_m}	$\ln(l_f - \bar{l}_f) \times \ln(l_m - \bar{l}_m) \times job\_noap_m$	−0.18	0.07	−2.6
δ_E	$\ln(l_f - \bar{l}_f) \times \ln(l_m - \bar{l}_m) \times East$	−0.56	0.04	−12.4
$\delta_{r_3^f}$	$\ln(l_f - \bar{l}_f) \times \ln(l_m - \bar{l}_m) \times reg3_f$	−1.49	0.13	−11.7
β_K^c	$\ln(c - \bar{c}) \times kid$	−10.82	1.92	−5.6
β_{K6}^c	$\ln(c - \bar{c}) \times kid6$	−3.77	1.19	−3.2
$\beta_{sr_f}^c$	$\ln(c - \bar{c}) \times sch\_real_f$	5.56	1.20	4.6
$\beta_{sa_f}^c$	$\ln(c - \bar{c}) \times sch\_abi_f$	5.28	1.46	3.6
$\beta_{r_3^f}^c$	$\ln(c - \bar{c}) \times reg3_f$	−16.94	1.25	−13.5
$\beta_{r_1^m}^c$	$\ln(c - \bar{c}) \times reg1_m$	4.21	0.97	4.3
β_1^c	$\ln(c - \bar{c})$, regime 1	26.94	1.92	14.0
β_2^c	$\ln(c - \bar{c})$, regime 2	10.81	3.01	3.6
β_3^c	$\ln(c - \bar{c})$, regime 3	−22.39	44.67	−0.5
e_1	'logit', regime 1	6.36	0.85	7.5
e_2	'logit', regime 2	1.58	1.05	1.5

Table 13 (continued)

	Coefficient	SE	*t* value
Log likelihood R=3		−4,218.75	
Log likelihood R=2		−4,224.75	
Log likelihood multinomial logit		−4,245.56	

kid and *kid*6 are indicator variables with value 1 if the couple has at least one child and one child less than 6 years old. sch_real_f, sch_real_m, sch_abi_f and sch_abi_m are indicator variables with value 1 if the wife (*f*) or the husband (*m*) have short and long secondary schooling. job_uni_f and job_noap_m are indicator variables with value 1, respectively, if the wife has university or college degree and if the husband has no training. *East* is an indicator variable with value 1 if the couple lives in East Germany. $reg3_f$ and $reg1_m$ are indicator variables with value 1 if the third consumption regime was the best one for the wife and the first consumption regime was the best one for the husband, respectively, in the calibration procedure. $(\ln age_f)^2$ is the square of the logarithm of the wife's age in years

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